FUEL CELL RESEARCH AT GRC:

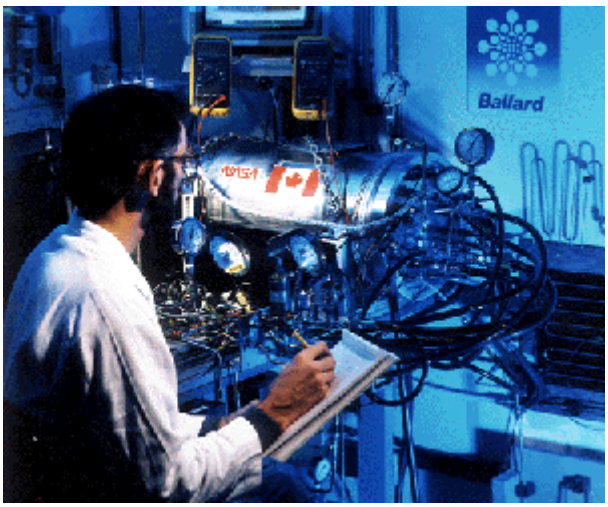
Evolution of fuel cell applications at GRC

http://www.grc.nasa.gov/WWW/Electrochemistry/doc/fuelcellapps.html
Page by Doris Britton, 11-7-2002

Highlights from the above link:

- 1995 Regenerative Fuel Cell (RFC) Test Bed for Government and Commercial Applications
http://www.grc.nasa.gov/WWW/RT1995/5000/5420p.htm
GRC's Electrochemical Technology Branch has led a multiagency effort to design, fabricate, and operate an RFC system testbed for space, military, and commercial uses. Construction of the 25-kW RFC testbed at the NASA facility at Edwards Air Force Base was completed in January 1995, and the system has been operational since then.

RFC systems provide efficient, environmentally friendly, highly reliable, renewable energy conversion. Systems consist of: fuel cells, electrolyzers, and photovoltaics. Fuel cells consume use hydrogen and oxygen electricity, water, and heat. A solar-powered electrolyzer breaks the water up into hydrogen and oxygen, so the fuel cell can use it. The fuel cell waste heat can also be utilized in many different ways. If the fuel cell is designed to consume air rather than pure oxygen, then the oxygen from water electrolysis can be used for other purposes, such as in biological waste purification.



- 1996 Balloon Fuel Cell Power System
http://www.grc.nasa.gov/WWW/RT1996/5000/5420l.htm

GRC teamed with the NASA Wallops Flight Facility to demonstrate the operation of a hydrogen-oxygen proton exchange membrane (PEM) fuel cell for application in the upper atmosphere. Wallops' Balloon Programs Branch had a requirement for a high-power, long-duration power system for use on a scientific balloon platform.

Their previous current power system did not meet these needs. The object was to deliver a 200-W (minimum) fuel cell system that can deliver approximately 10 kWh of electrical energy. The fuel cell power system had to be able to withstand physical forces reaching as high as 8 to 10g. The initial flight was scheduled for early Summer 1997.

- Zero CO2 Research: http://www.grc.nasa.gov/WWW/AERO/base/zero.htm
This project's purpose is to eliminate of carbon dioxide (CO2) emissions from civil transportation aircraft by converting their propulsion systems to hydrogen fuel. As part of this project, GRC wants to introduce new technologies to use surrounding air to create energy. The goal is to drastically reduce global climate change by having zero CO2 emissions, and reducing NOx (nitrogen oxides) emissions more 5 times in order to reduce stress on the ozone layer.

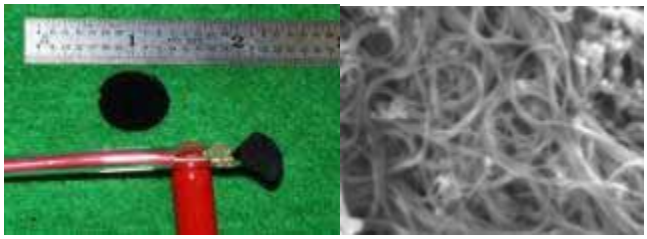
- Second Generation Fuel Cells: (link not working properly)
http://stpo.grc.nasa.gov/Project_Home/Project_Home.htm

- Regenerative Fuel Cell System: http://space-power.grc.nasa.gov/ppo/
On April 8, 2003 the GRC flywheel team experimentally demonstrated a two flywheel module system simultaneously regulating a power bus and providing a commanded output torque.

- Revolutionary Aeropropulsion Concepts: http://www.grc.nasa.gov/WWW/AERO/base/rac.htm
This project includes as one of three objectives: "Non-Turbomachinery Based Components and Systems", seeking to enable emissionless propulsion.

- Nanotechnology: http://www.grc.nasa.gov/WWW/Electrochemistry/doc/nanotech.html
This project assesses the technical feasibility of using carbon nanotubes and nano-scale materials to enhance the performance of electrochemical energy storage devices. Nanotechnology involves electronic circuits and devices from single atoms and molecules.

- hydrogen storage material
- hydrogen/air fuel cell



What are fuel cells and their environmental benefits?

In the 1830's, a Welch judge by the name of Sir William Robert Grove first produced electricity by creating the fuel cell process (explained below). But it didn't catch on, because around that same time the internal combustion engine was developed in Germany and reserves of petroleum were being discovered world-wide. It was the beginning of the fossil fuel age, and more people were enjoying a higher standard of living because of this cheap energy and machines to do the work. No one knew the environmental and health effects of burning fossil fuels.

Burning petroleum as a fuel increases global warming and smog. Plus, reserves of petroleum are not renewable, and the U.S. has little control over its price and availability. In the United States, energy use is the largest single source of air pollution. Fuel cells have reduced or nonexistent emissions, with the by-products usually heat and water. (from http://www.fuelcellstore.com/information/coming_of_age.html

How do you make a fuel cells? First you make a box (cell) with a negative electrode on one side and a positive electrode on the other. Then you add come sort of fuel, such as hydrogen, hydrocarbons, alcohol, hydrazine, or others. And at the same time you add an oxidant. An oxidant takes a molecule of the fuel and adds oxygen to it (oxidizing it). This oxidation strips electrons, which creates the electricity, along with heat and by-products that are not needed. (The oxidants used are usually pure oxygen and air.) Fuel cells will continue to generate electricity as long as both fuel and oxidant are available. A scientific explanation with a diagram are here:
http://www.grc.nasa.gov/WWW/Electrochemistry/doc/fuelcell.html